



TF

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of

Simon DELEONIBUS

Group Art Unit: 2826

Application No.: 10/591,863

Examiner: W. KUO

Filed: September 6, 2006

Docket No.: 129344

For: FIELD EFFECT TRANSISTOR WITH SUITABLE SOURCE, DRAIN AND
CHANNEL MATERIALS AND INTEGRATED CIRCUIT COMPRISING SAME

REQUEST FOR RECONSIDERATION

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In reply to the October 22, 2008 Office Action, reconsideration of the application is respectfully requested in light of the following remarks. Claims 3-5 are pending in this application.

The Office Action rejects claim 4 under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 7,009,200 to Tezuka et al. (hereinafter "Tezuka") in view of U.S. Patent Application Publication No. 2003/0011009 to Zhang et al. (hereinafter "Zhang"). This rejection is respectfully traversed.

The Office Action concedes that Tezuka does not teach that the source material and drain material are different materials. The Office Action asserts that Zhang remedies these shortfalls of Tezuka. The analysis of the Office Action fails for the following reason.

Claim 4 recites, among other features, the source, the drain and the channel materials being selected such that an upper level of a valence band of the drain material is higher than

an upper level of a valence band of the channel material and an upper level of a valence band of the source material is lower than the upper level of the valence band of the channel material. The Office Action asserts that Tezuka teaches these features at Fig. 1C. As noted above, the Office Action concedes that Tezuka does not teach that the source and drain materials are different materials. The upper level of a valence band of the material is a material property. Thus, because the source and drain materials of Tezuka are the same, the upper level of a valence band of the source and drain materials of Tezuka is identical.

Fig. 1C is included in Tezuka to demonstrate how the strained channel material alters the electric field within the drain to accelerate electrons more rapidly in the channel regions (see continuous line in the channel compared with dashed line in Fig. 1C of Tezuka). In Fig. 1C the transistor is depicted while in operation, thus a bias voltage is present between the source and drain. The upper level of the valence band is thus shifted by the bias voltage between the source and drain. Therefore, Tezuka would not have suggested at an upper level of a valence band of the drain material is higher than an upper level of a valence band of the channel material and an upper level of a valence band of the source material is lower than the upper level of the valence band of the channel material because the upper level of a valence band of the source materials of Tezuka are identical.

Claim 4 recites, among other features, the source material and drain material are different materials. The Office Action asserts that this feature is disclosed by Zhang. Zhang teaches, at paragraph [0029], "[i]n this embodiment, the first metal silicide material 114 comprises ErSi and the second metal silicide material 116 comprises PtSi. Thus, the drain of the N-channel device 110 and the source of the P-channel device 108 are formed of ErSi while the source of the N-channel device 110 and the drain of the P-channel device 108 are formed of PtSi." Further, Zhang teaches at, *e.g.*, paragraph [0002], "[m]etal silicides are used to form natural Schottky barriers to silicon substrates that confine the carriers, reducing or

eliminating the need for dopant impurities in the channel." Thus, Zhang teaches the channel made from undoped silicon. Zhang teaches, at, *e.g.*, paragraph [0031], the specific requirements regarding work function, valence band, conduction band or the source drain and channel materials. Tezuka teaches, at, *e.g.*, col. 2, lines 48-29, "[t]he first embodiment is a pMOSFET which has a strained-Si_{1-x}Ge_x layer 20 as a channel formed on a SiO₂ film 12 as shown in FIG. 1A." Thus, the channel material of Tezuka is different from that of Zhang, and therefore the conduction and valence band energies of the channel of Tezuka are different from those of the channel of Zhang. In view of the discussion in Zhang, at, *e.g.*, paragraph [0031] and the fact that the source and drain materials of Zhang are metals (see, *e.g.* paragraph [0029] of Zhang) and do not have an upper valence band energy, and further in view of the fact that Tezuka teaches a source and drain from by doping SiGe with a P-type impurity (see, *e.g.*, col. 2, lines 53-55), it would not have been predictable to combine the source and drain materials of Zhang with the channel of Tezuka as asserted by the Office Action with any reasonable expectation of success in addressing the features recited in claim 4.

For at least the foregoing reasons, the combination of Tezuka with Zhang cannot reasonably be considered to have suggested the combination of all of the features recited in claim 4.

Accordingly, reconsideration and withdrawal of the rejection of claim 4 under 35 U.S.C. 103(a) as being unpatentable over Tezuka in view of Zhang are respectfully requested.

The Office Action rejects claims 3 and 5 under 35 U.S.C. §103(a) as being unpatentable over Tezuka in view of U.S. Patent No. 4,885,614 to Furukawa et al. (hereinafter "Furukawa") further in view of U.S. Patent No. 2,918,396 to Hall. This rejection is respectfully traversed.

The Office Action concedes that Tezuka does not teach the source material and the drain material are different materials. The analysis of the Office Action fails for the following reasons.

The Office Action fails to indicate which of Furukawa and Hall would have suggested the source material and the drain material are different materials, or how it would have otherwise been suggested by the prior art.

The Office Action asserts that it would have been obvious to provide the transistor source of Tezuka with the diamond structure of carbon of Furukawa and further modify the diamond structure of carbon of Furukawa with the silicon-carbon alloy of Hall.

Further, the Office Action concedes that Tezuka does not explicitly teach the benefits of using silicon-carbon alloy without germanium. The Office Action asserts that Furukawa with Hall remedies this shortfall of Tezuka. This analysis fails for the following reason.

Furukawa teaches incorporating carbon into a silicon-germanium alloy (see, *e.g.*, col. 2, lines 3-10), a feature already disclosed by Tezuka. Furukawa would not have suggested the removal of germanium from a silicon-germanium-carbon alloy. Hall discloses silicon-carbide (see *e.g.*, col. 1, lines 15-18). Hall would not have suggested removing germanium from a silicon-germanium-carbon alloy. Hall would not have suggested any alloy with germanium. Further, Hall teaches, a rectifier (see *e.g.*, col. 6, line 16) and NPN and PNP junction transistors (see *e.g.*, col. 6, line 63 - col. 7, line 27) with a base, collector and emitter. Hall would not have suggested a source or drain material.

Furukawa teaches, at, *e.g.*, col. 3, lines 16-19, that lattice constant of a crystal (with a diamond structure) of carbon which is a group for element like silicon and germanium is smaller than that of silicon crystal. This portion of Furukawa merely indicates that the crystal of carbon is diamond as opposed to graphite, and would have not suggested carbon within an alloy of silicon, germanium or silicon-germanium. Further, Furukawa would not have

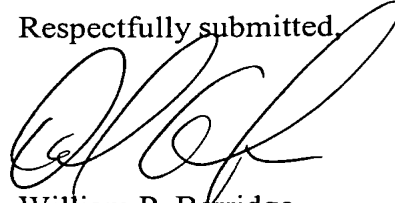
suggested pure carbon in the form of a diamond as a source or drain material, or even as a semi-conductor material. Accordingly, the combination of Tezuka with Furukawa and Hall would not have suggested a silicon-carbide source or drain material. Therefore, this combination of references would not have suggested an electron affinity of the source material is higher than the electron affinity of the channel material, as recited in claims 3 and 5.

For at least the foregoing reasons, the combination of Tezuka with Furukawa and Hall cannot reasonably be considered to have suggested the combinations of all of the features recited in claims 3 and 5. Accordingly, reconsideration and withdrawal of the rejection of claims 3 and 5 under 35 U.S.C. 103(a) as being unpatentable over Tezuka in view of Furukawa further in view of Hall are respectfully requested.

In view of the foregoing, it is respectfully submitted that this application is in condition for allowance. Favorable reconsideration and prompt allowance of claims 3-5 are earnestly solicited.

Should the Examiner believe that anything further would be desirable in order to place this application in even better condition for allowance, the Examiner is invited to contact the undersigned at the telephone number set forth below.

Respectfully submitted,



William P. Berridge
Registration No. 30,024

Daniel A. Tanner, III
Registration No. 54,734

WPB:MIL/add

Date: January 22, 2009

OLIFF & BERRIDGE, PLC
P.O. Box 320850
Alexandria, Virginia 22320-4850
Telephone: (703) 836-6400

| |
|--|
| DEPOSIT ACCOUNT USE AUTHORIZATION Please grant any extension necessary for entry; Charge any fee due to our Deposit Account No. 15-0461 |
|--|